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(12) **United States Patent**
Goodman

(10) **Patent No.:** **US 6,542,585 B2**
(45) **Date of Patent:** ***Apr. 1, 2003**

(54) **DISTRIBUTED SPLITTER FOR DATA TRANSMISSION OVER TWISTED WIRE PAIRS**

(58) **Field of Search** 379/90.01, 102.01-102.03, 379/93.17, 93.26, 93.28, 93.37, 93.01; 348/14.01, 14.08-14.13, 734

(75) **Inventor:** **David D. Goodman, Arlington, VA (US)**

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(73) **Assignee:** **Inline Connection Corporation, Arlington, VA (US)**

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(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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This patent is subject to a terminal disclaimer.

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(57) **ABSTRACT**

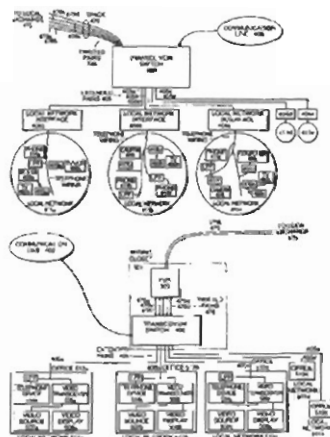
Related U.S. Application Data

(63) Continuation of application No. 09/874,733, filed on Jun. 5, 2001, which is a continuation of application No. 09/362,180, filed on Jul. 27, 1999, now Pat. No. 6,243,446, which is a continuation of application No. 09/191,168, filed on Nov. 13, 1998, now Pat. No. 6,185,284, which is a continuation of application No. 08/814,837, filed on Mar. 11, 1997, now Pat. No. 5,844,596, which is a continuation of application No. 08/673,577, filed on Jul. 1, 1996, now abandoned, which is a continuation of application No. 08/545,937, filed on Oct. 20, 1995, now abandoned, which is a continuation of application No. 08/372,561, filed on Jan. 13, 1995, now abandoned, which is a continuation of application No. 08/245,759, filed on May 18, 1994, now abandoned, which is a continuation of application No. 08/115,930, filed on Aug. 31, 1993, now abandoned, which is a continuation of application No. 07/802,738, filed on Dec. 5, 1991, now abandoned, which is a continuation-in-part of application No. 07/688,864, filed on Apr. 19, 1991, now abandoned, which is a continuation of application No. 07/379,751, filed on Jul. 14, 1989, now Pat. No. 5,010,399.

(51) **Int. Cl.** **H04M 11/00**

(52) **U.S. Cl.** **379/93.01; 379/90.01**

9 Claims, 25 Drawing Sheets



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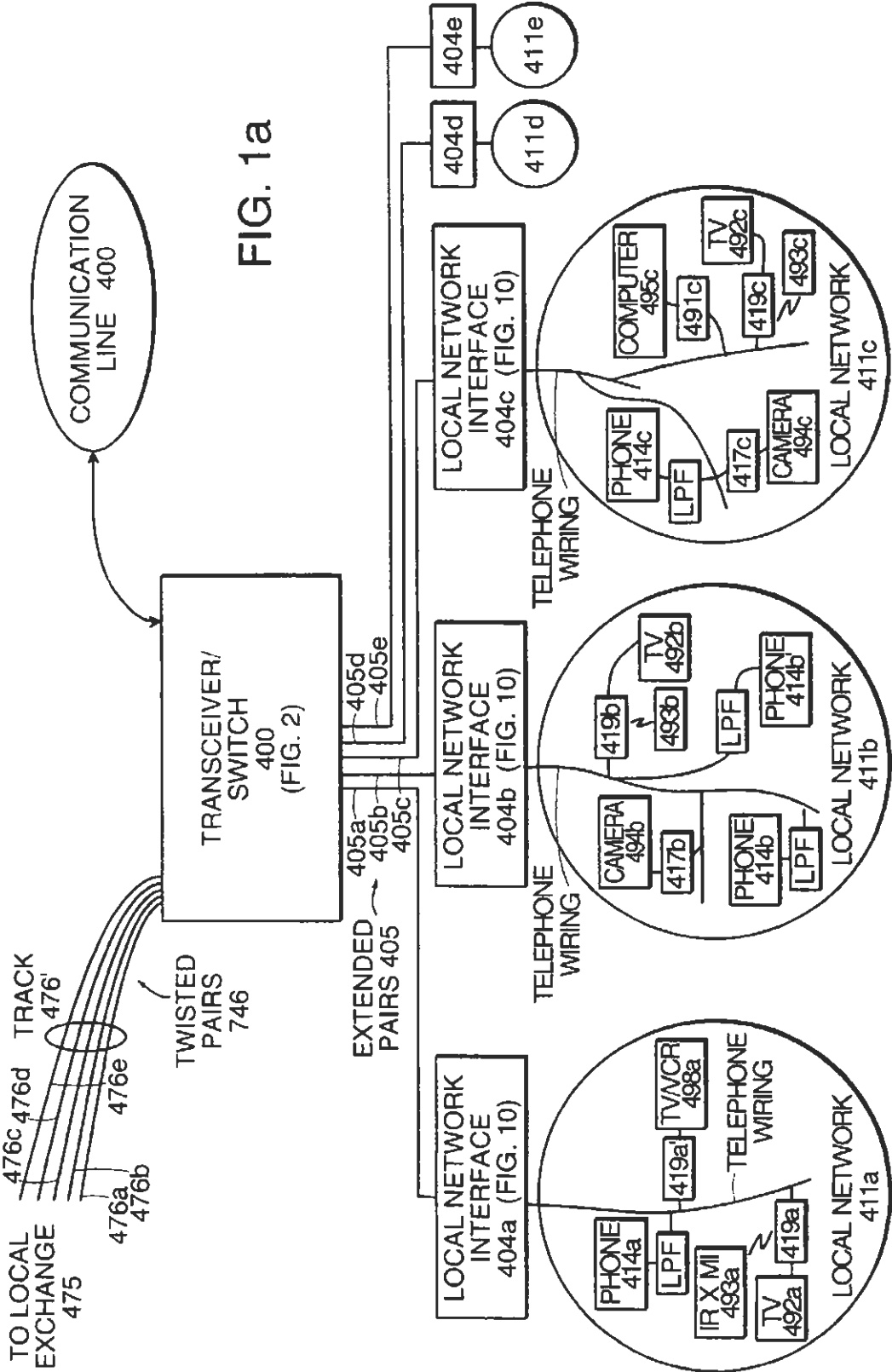
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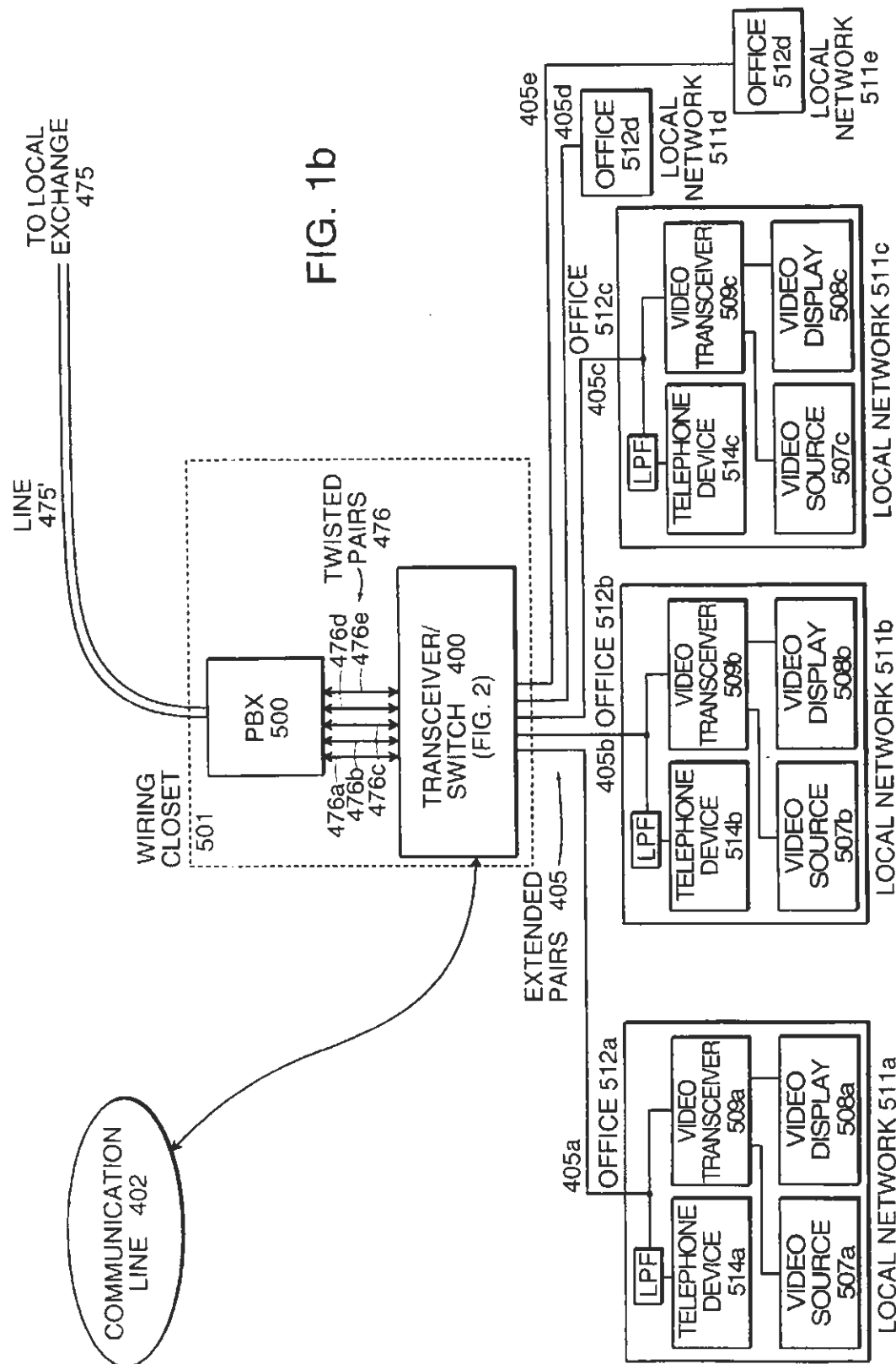
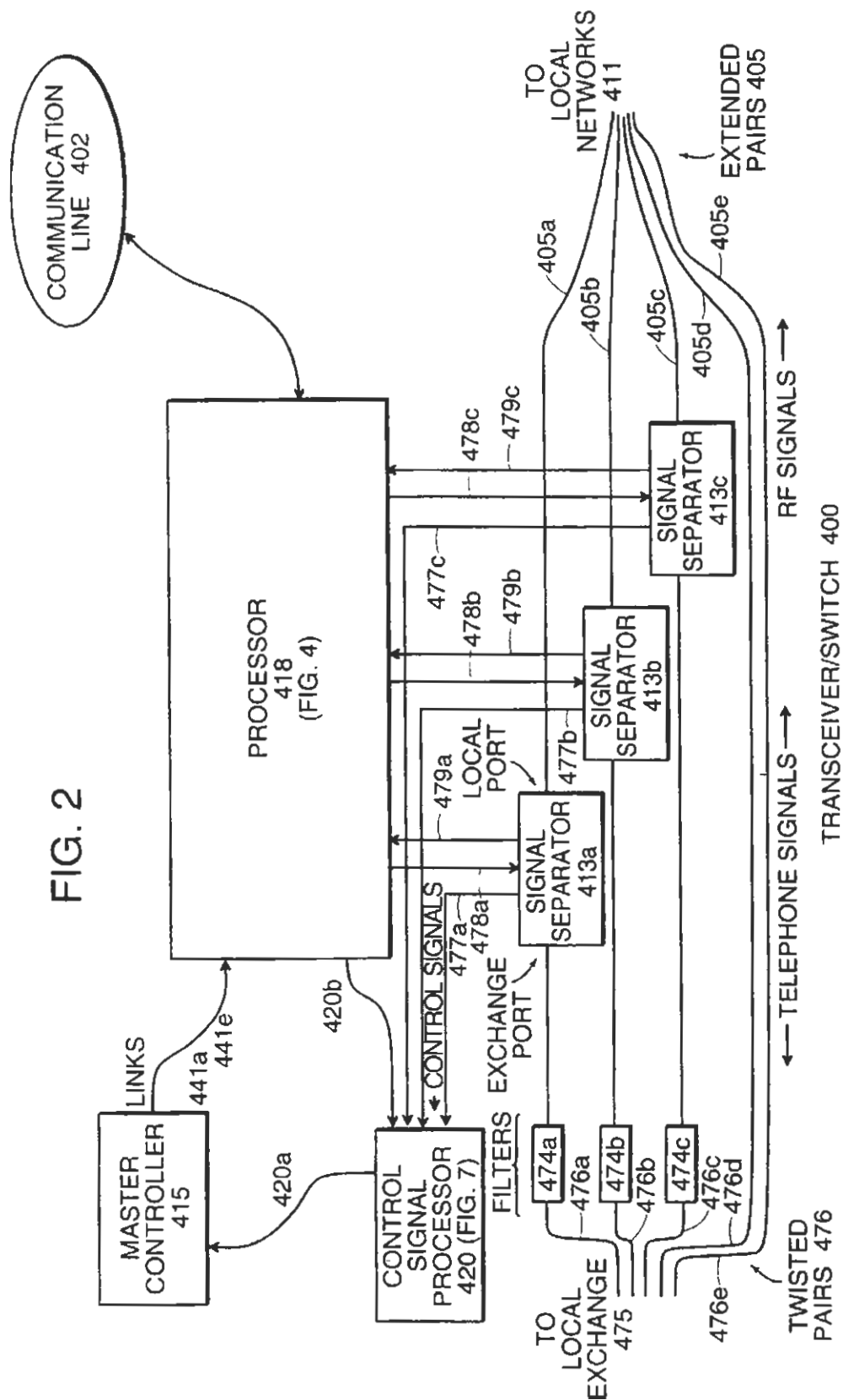


FIG. 2

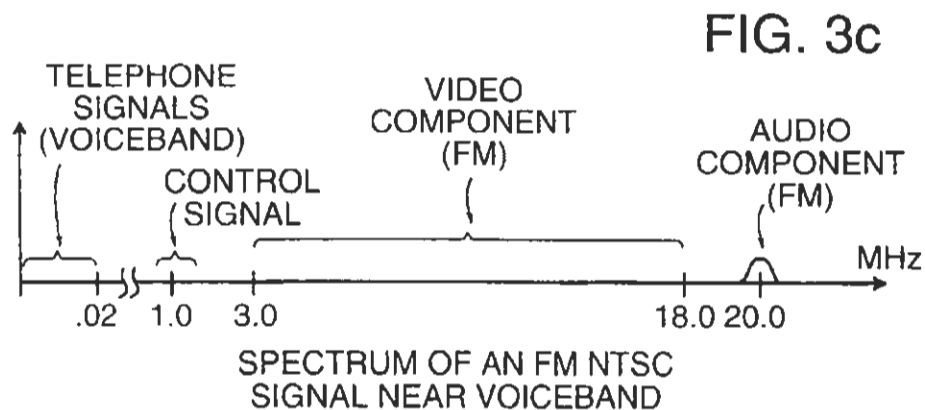
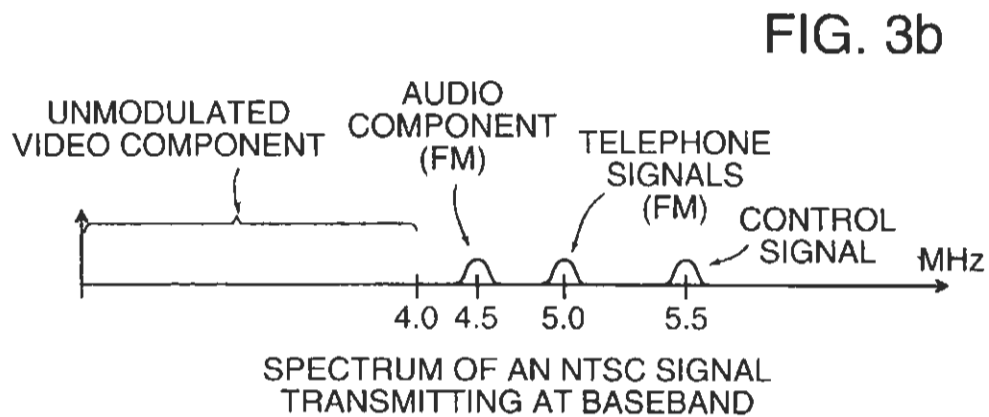
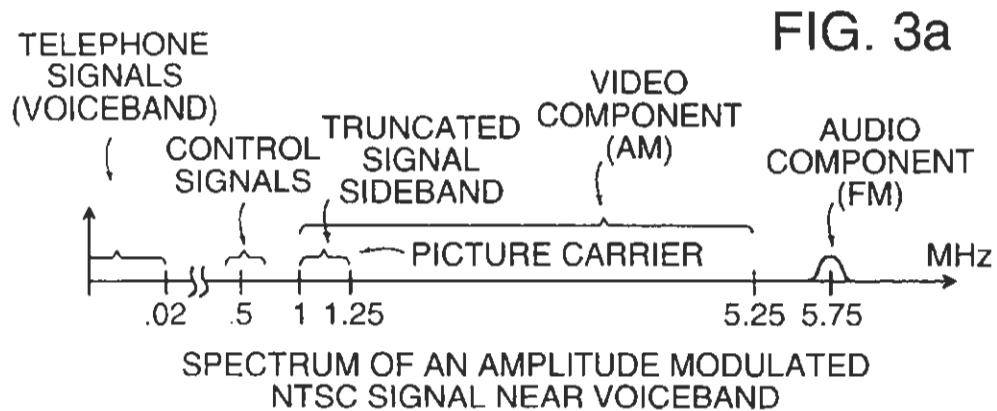


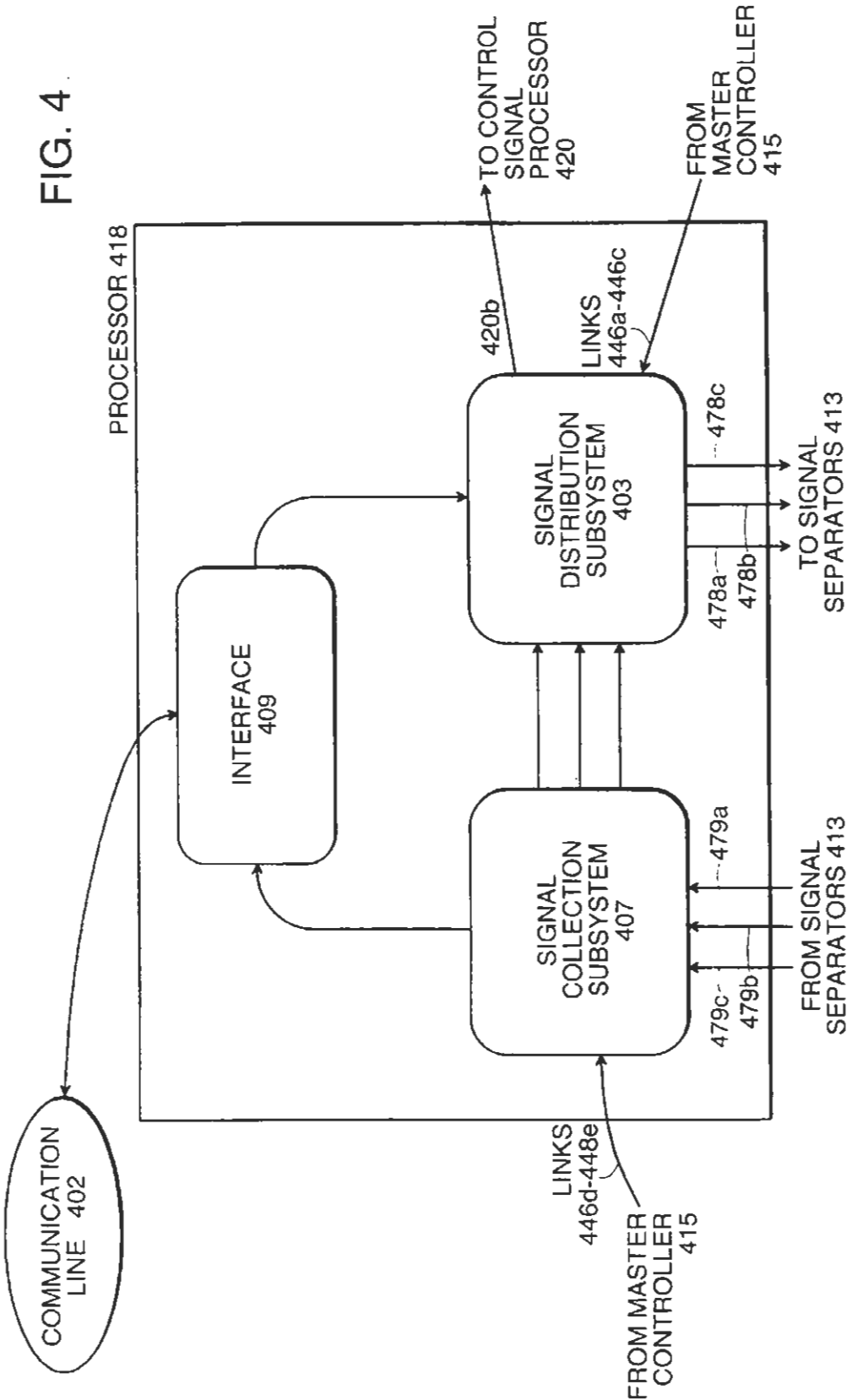
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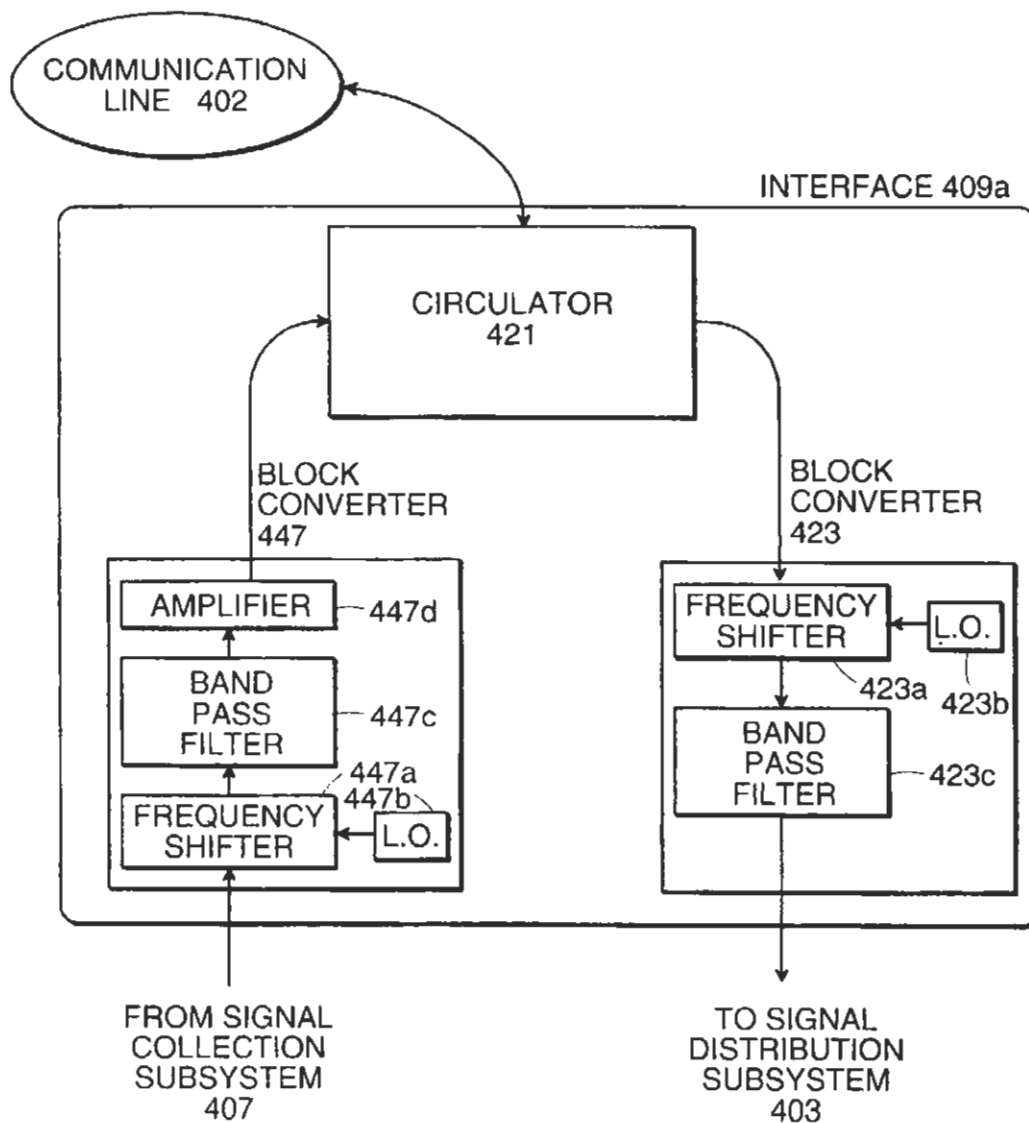


FIG. 4a

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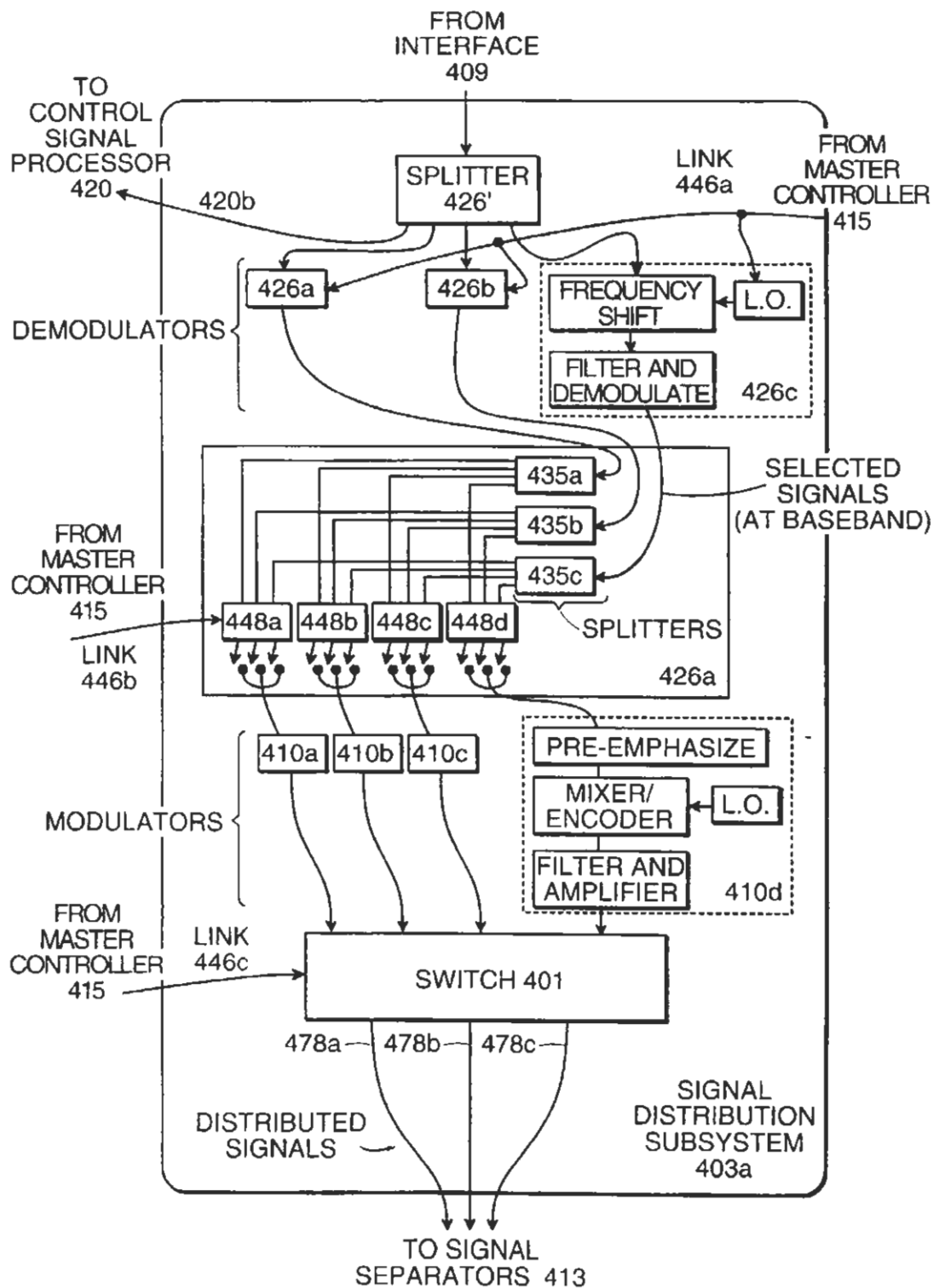


FIG. 5a

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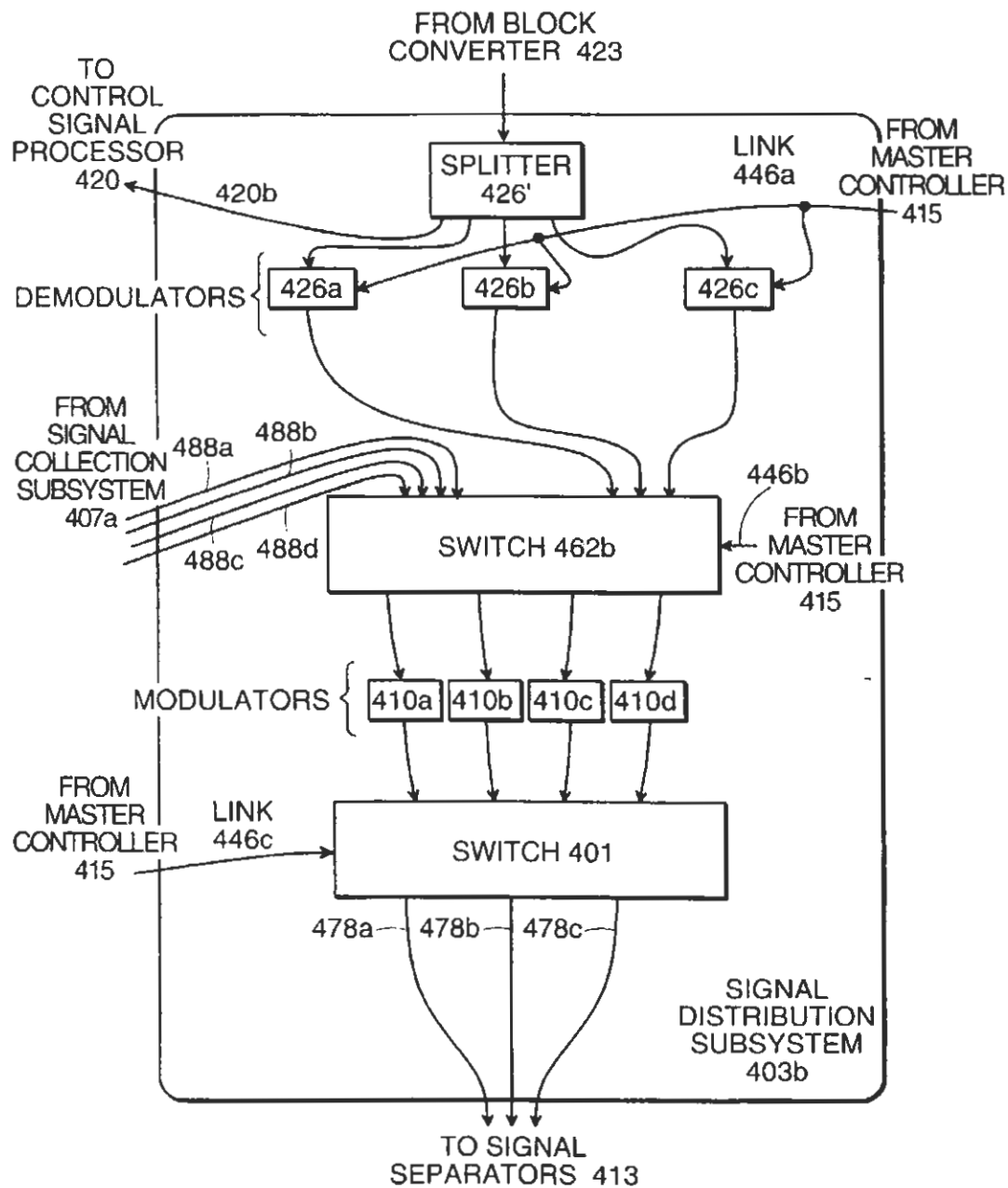


FIG. 5b

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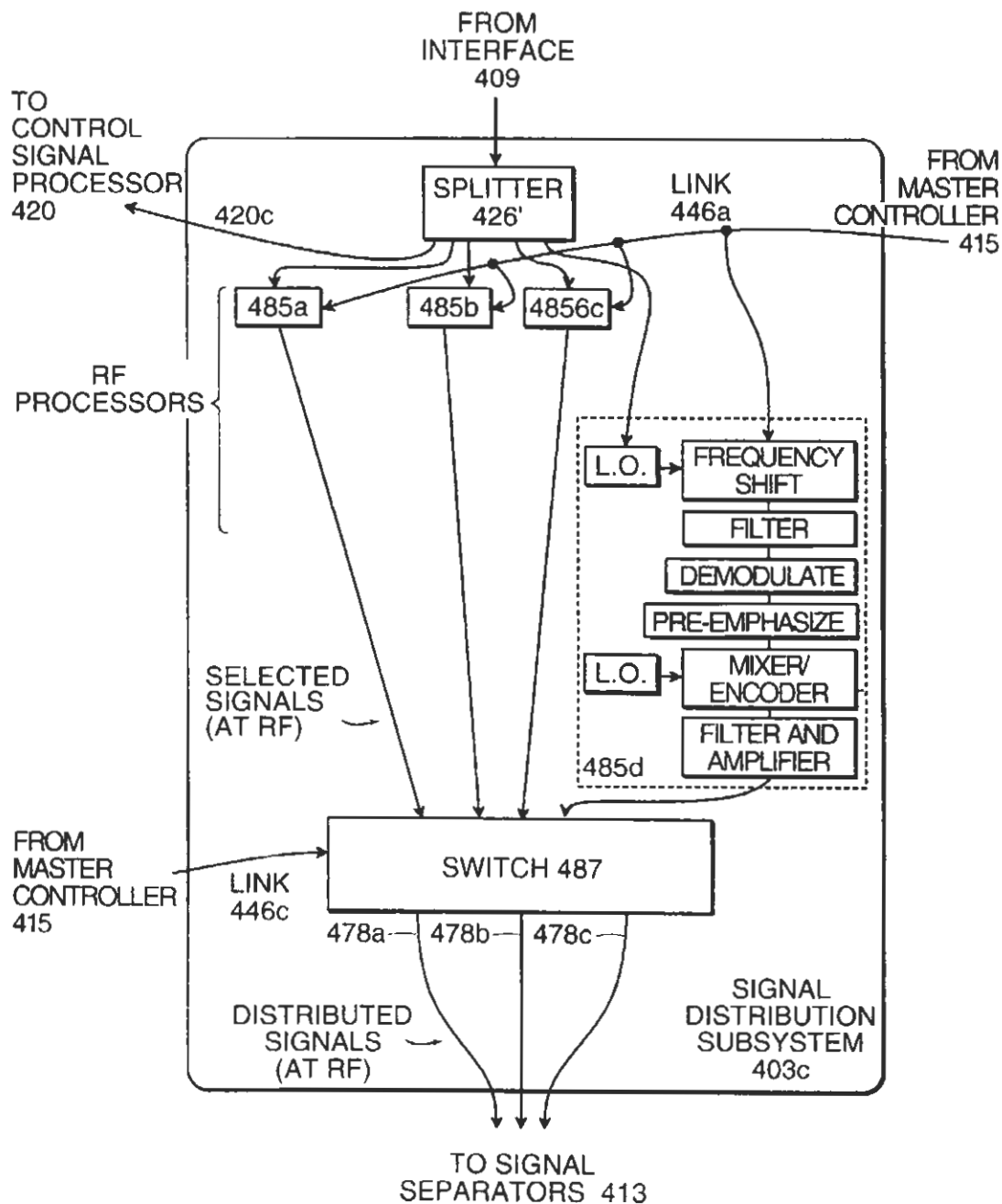


FIG. 5c

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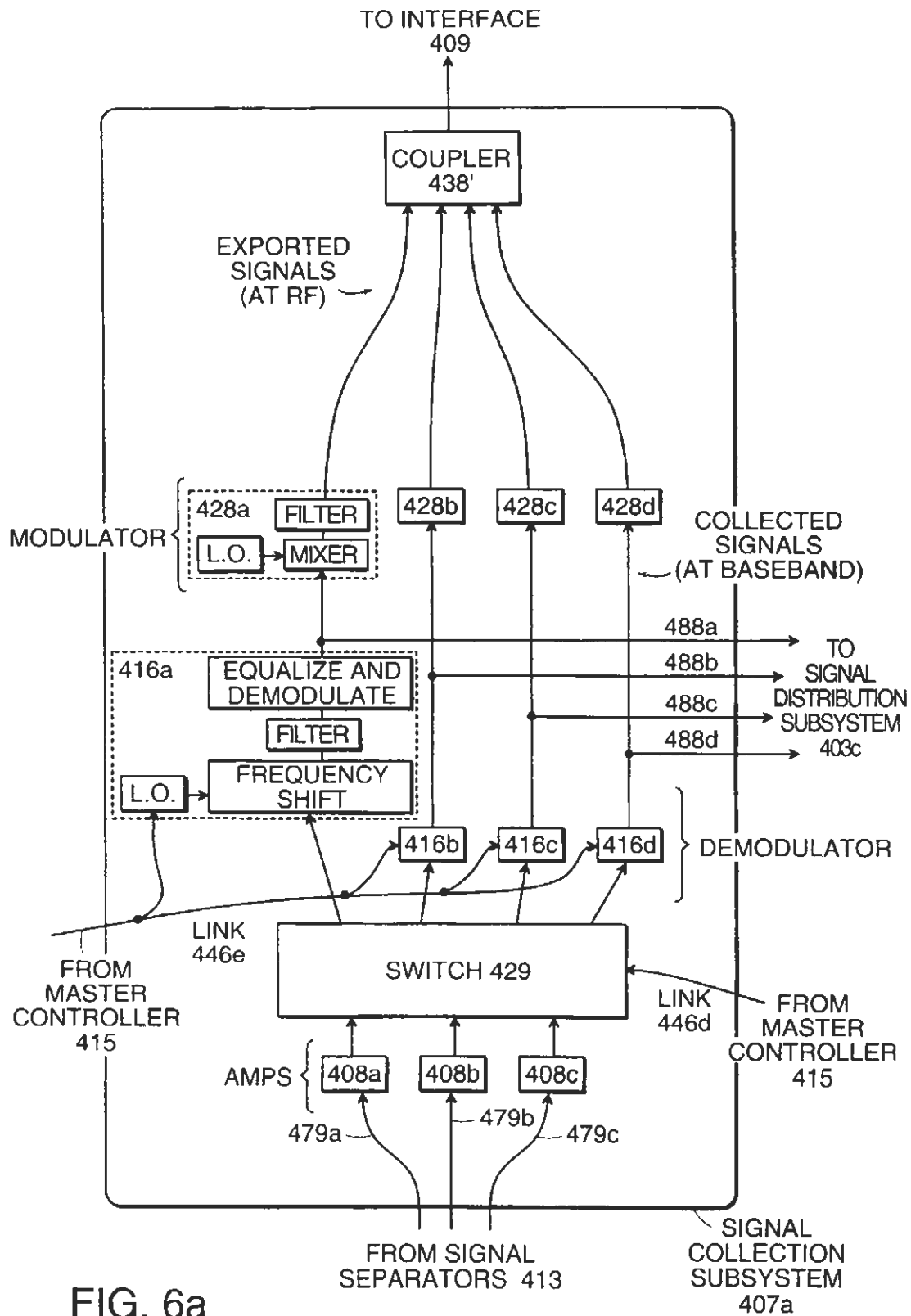


FIG. 6a

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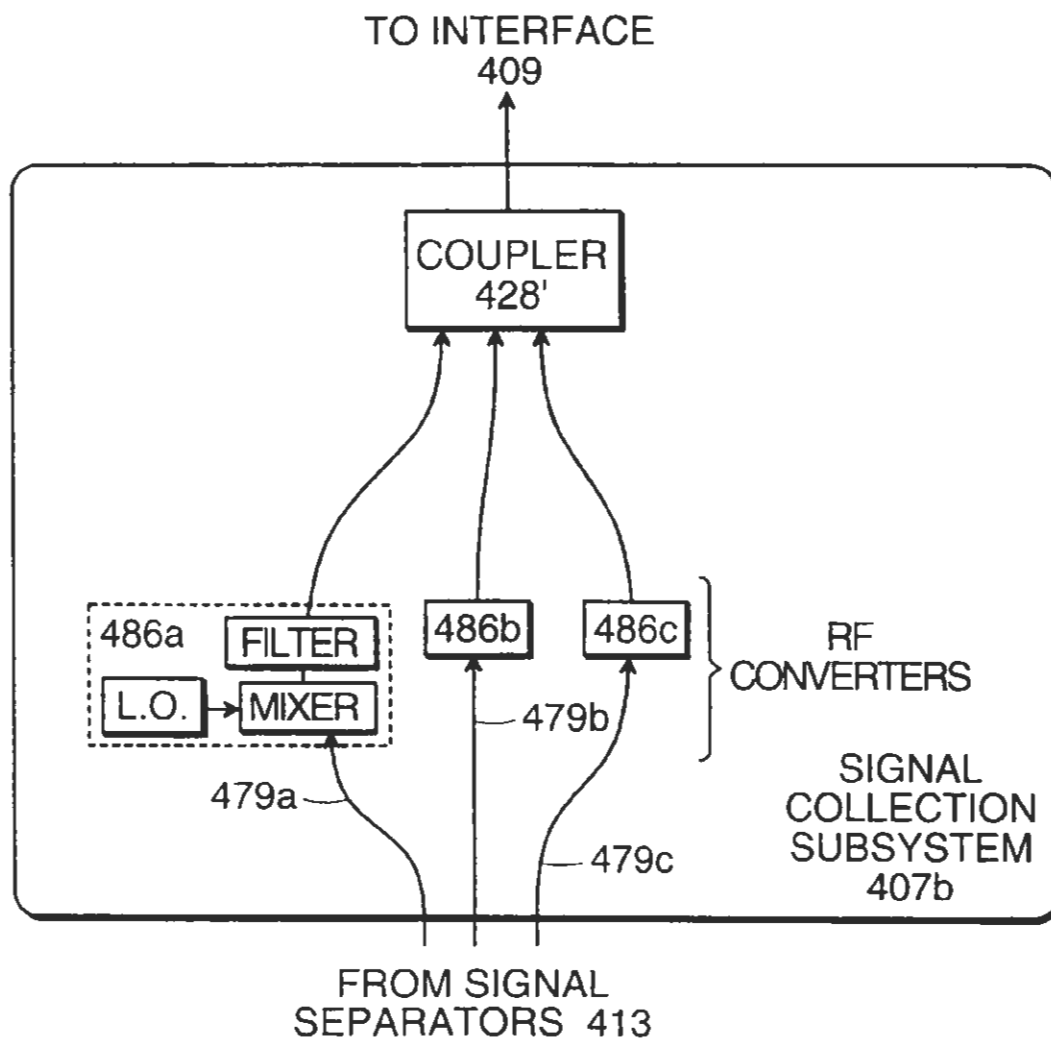


FIG. 6b

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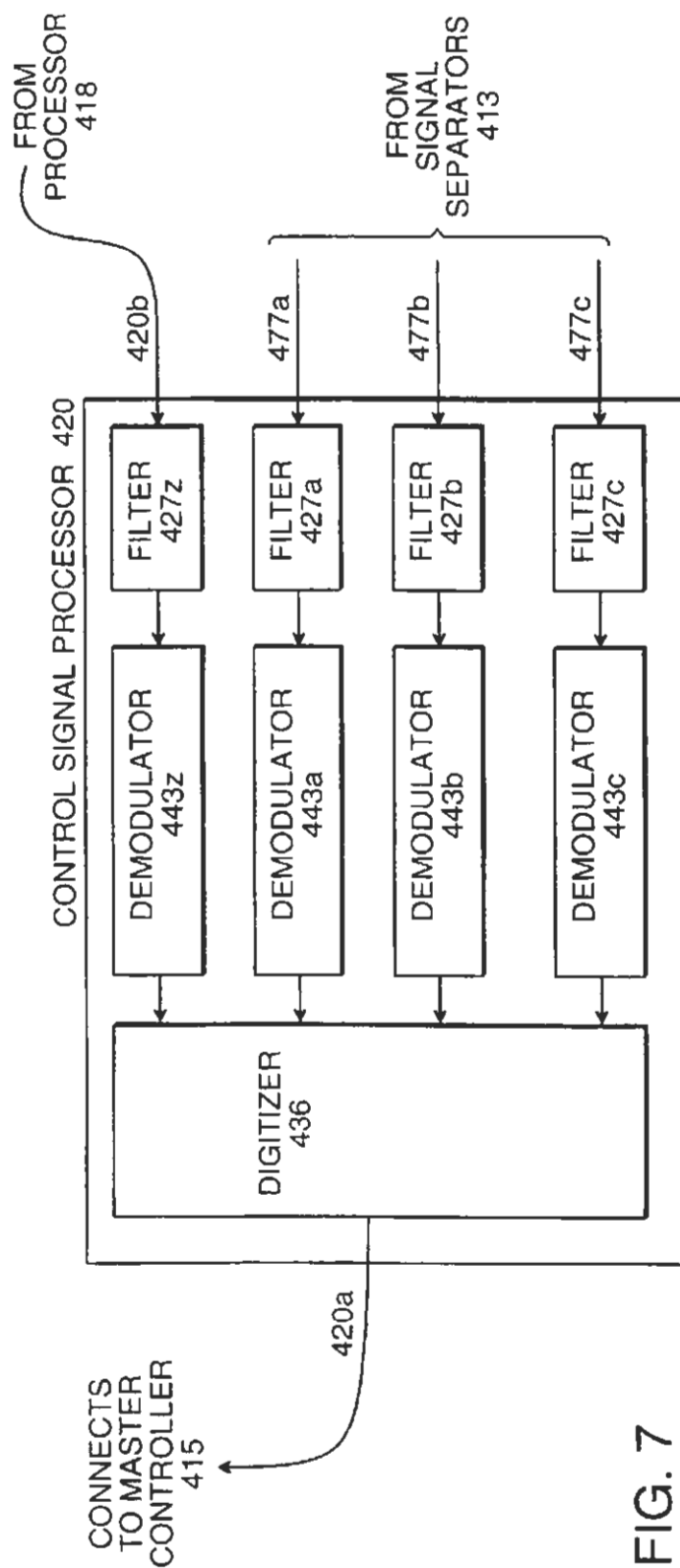


FIG. 7

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FIG. 8

	FREQUENCY DURING TRANSMISSION OVER EXTENDED PAIRS (MHz)				FREQUENCY DURING TRANSMISSION OVER LOCAL NETWORKS (MHz)			
	ORIGIN/DEST	405a	405b	405c	411a	411b	411c	
CONTROL A	493a/415	22.75-23.25			22.75-23.25			
B	493b/415		22.75-23.25			22.75-23.25		
C	493c/415			22.75-23.25			22.75-23.25	
VIDEO U	402/492a	1-6(AM)			12-18(AM)			
	V 402/492b ^{492c} 498a	7-22(FM)	1-6(AM)	1-6(AM)	24-30(AM)	54-60(AM)	12-18(AM)	
	W 494b/402		24-54(FM)			6-12(AM)		
	X 494c/402			24-54(FM)			6-12(AM)	
DIGITAL Y	402/495c			6-18				18-40
	Z 495c/402			54-100				1-6

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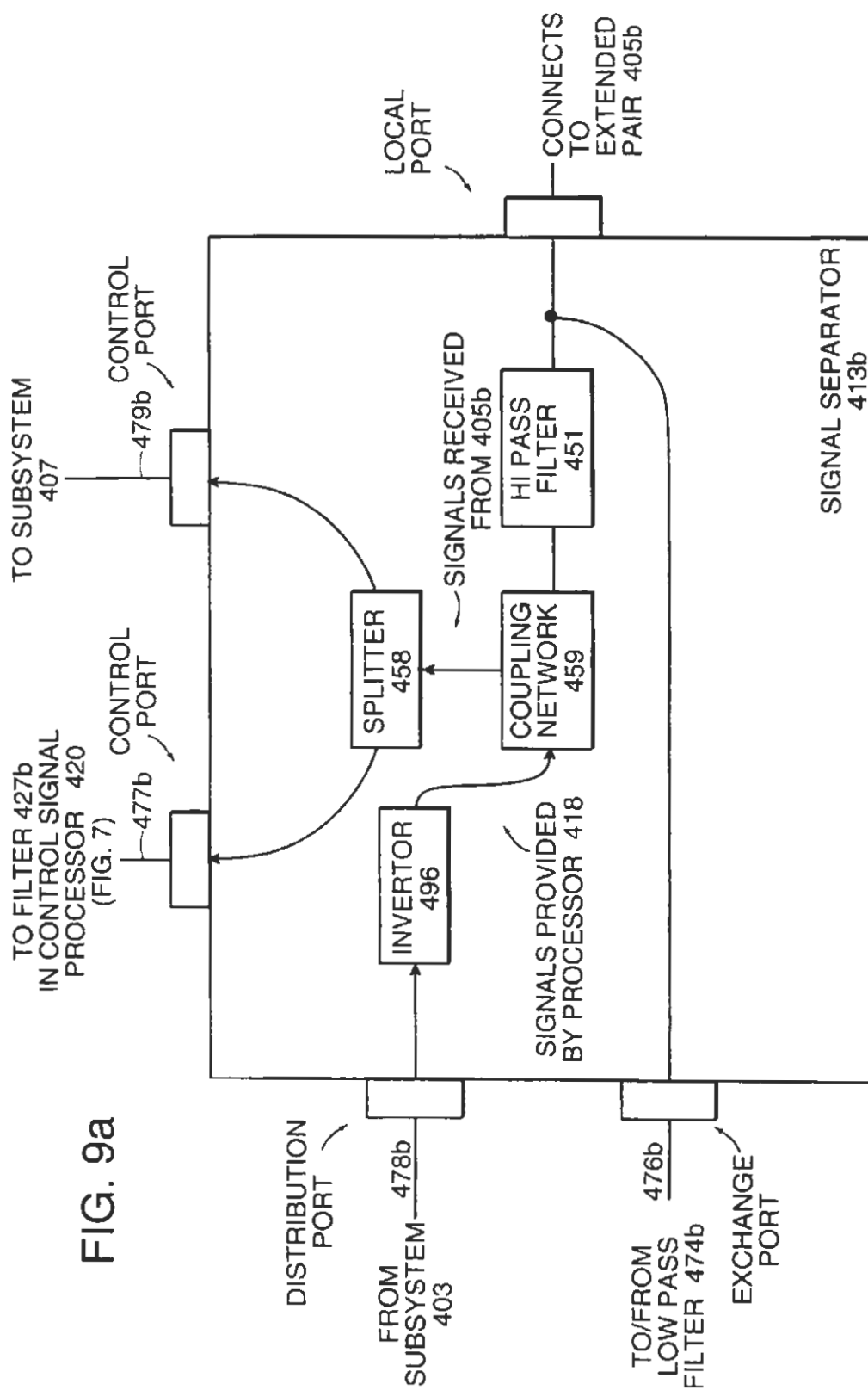


FIG. 9b

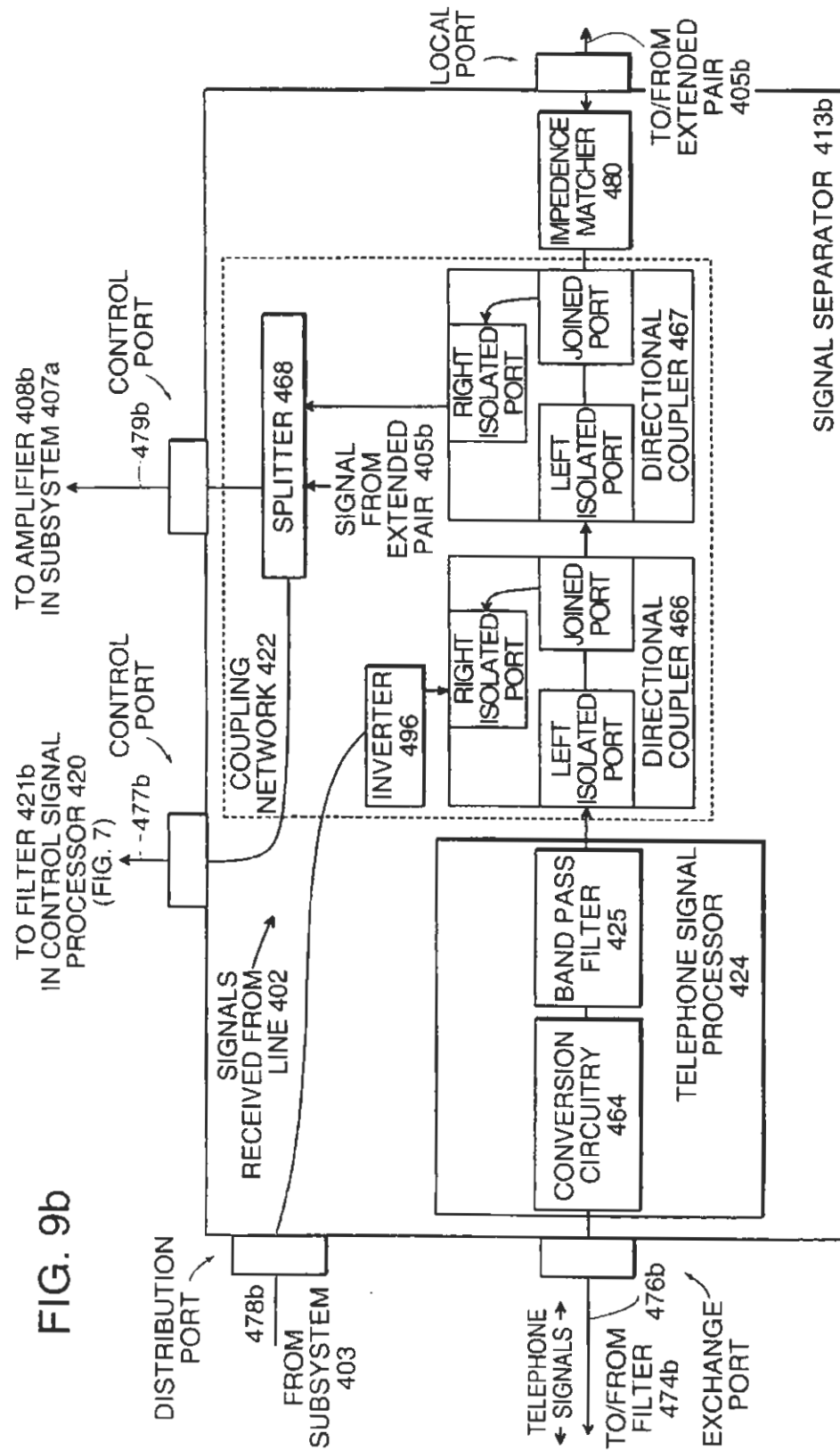
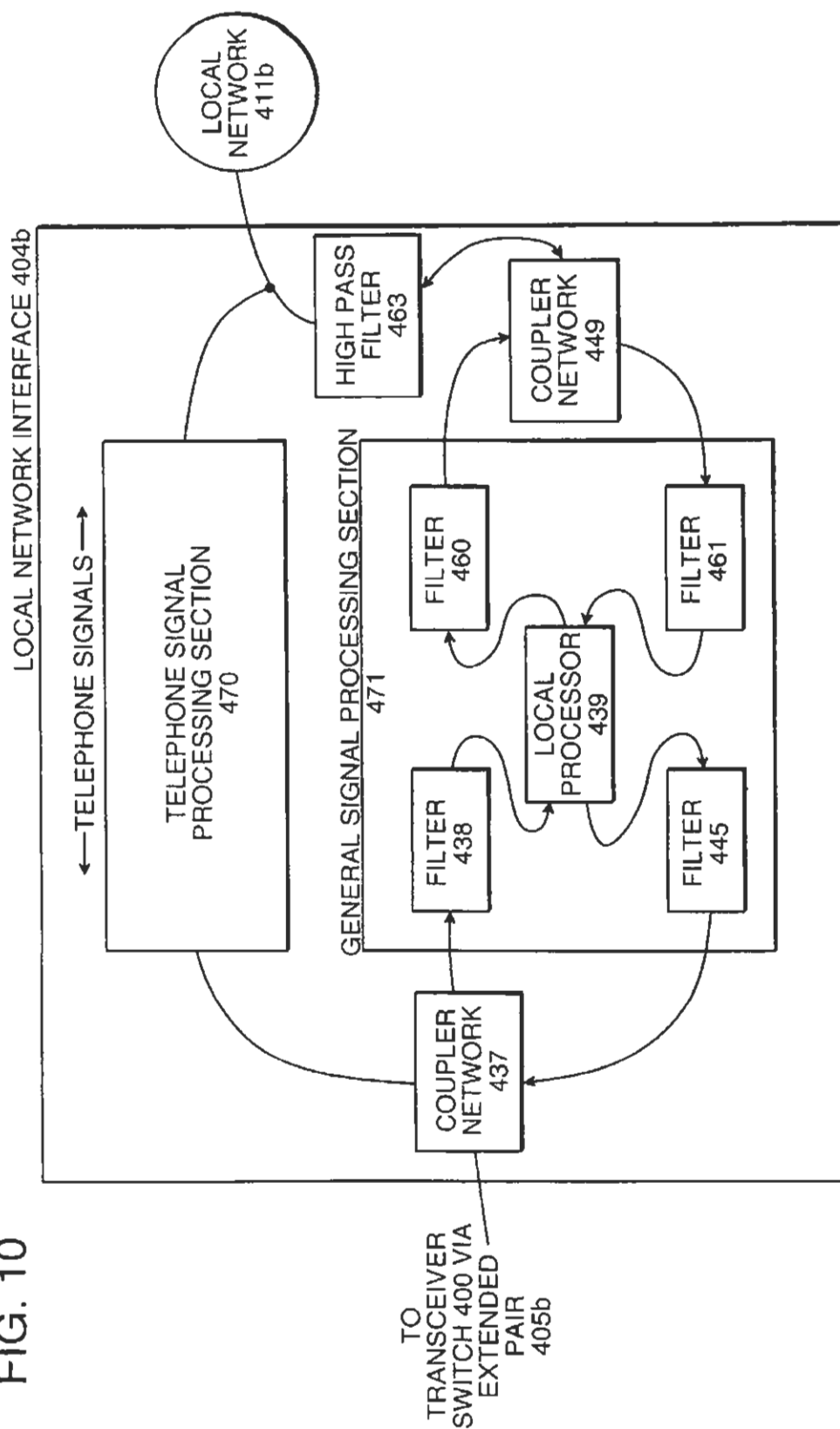


FIG. 10



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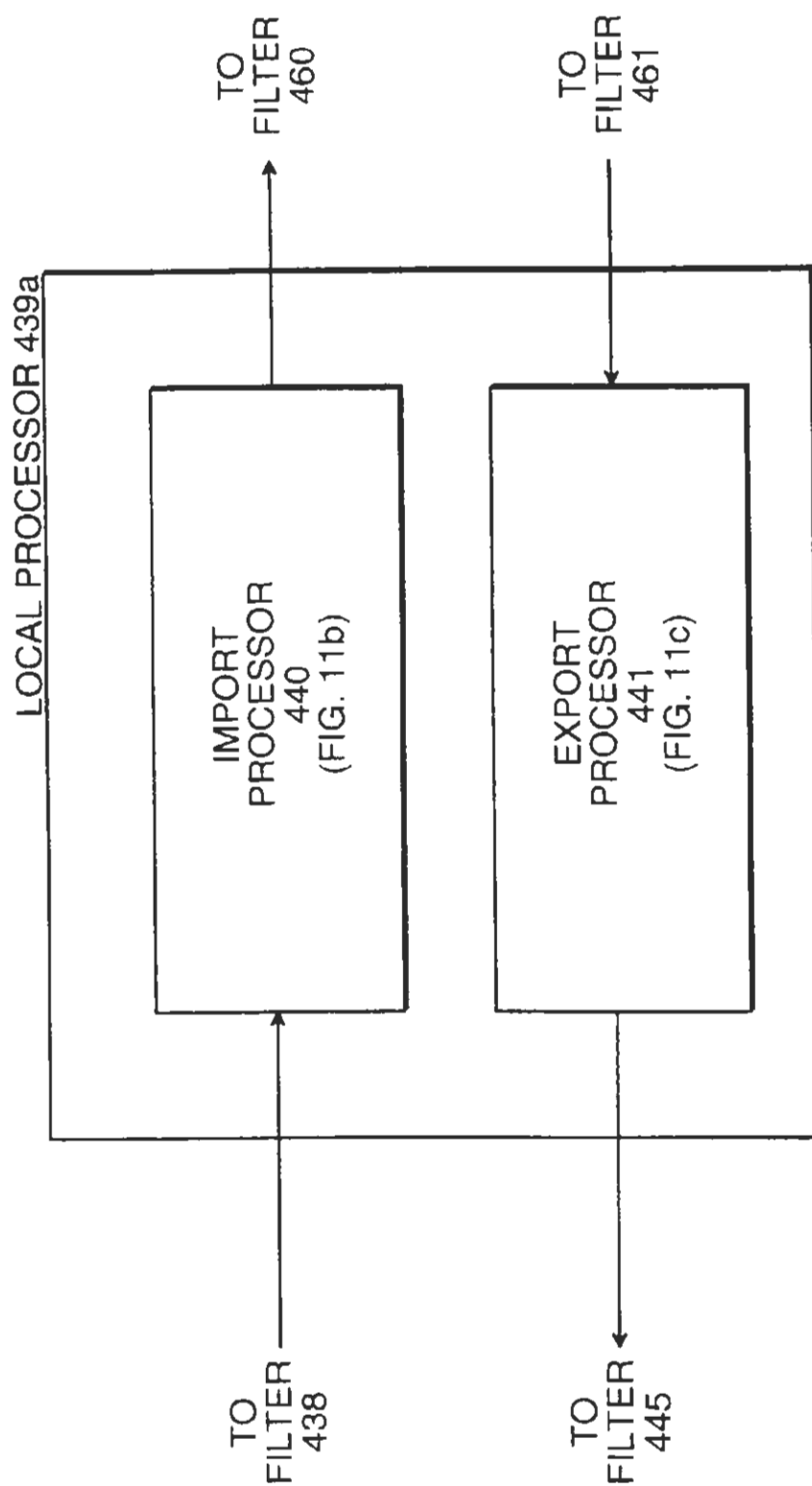


FIG. 11a

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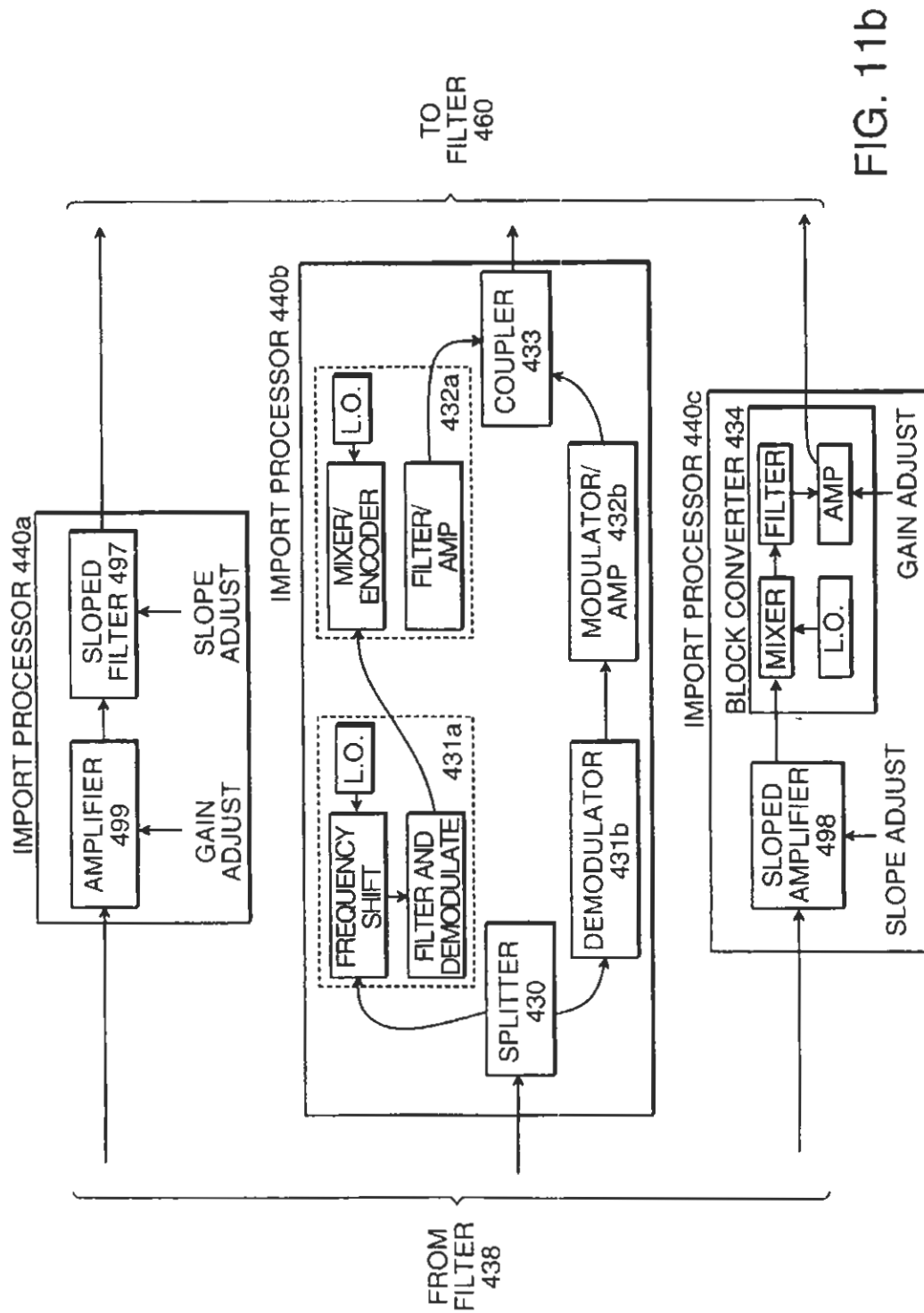


FIG. 11b

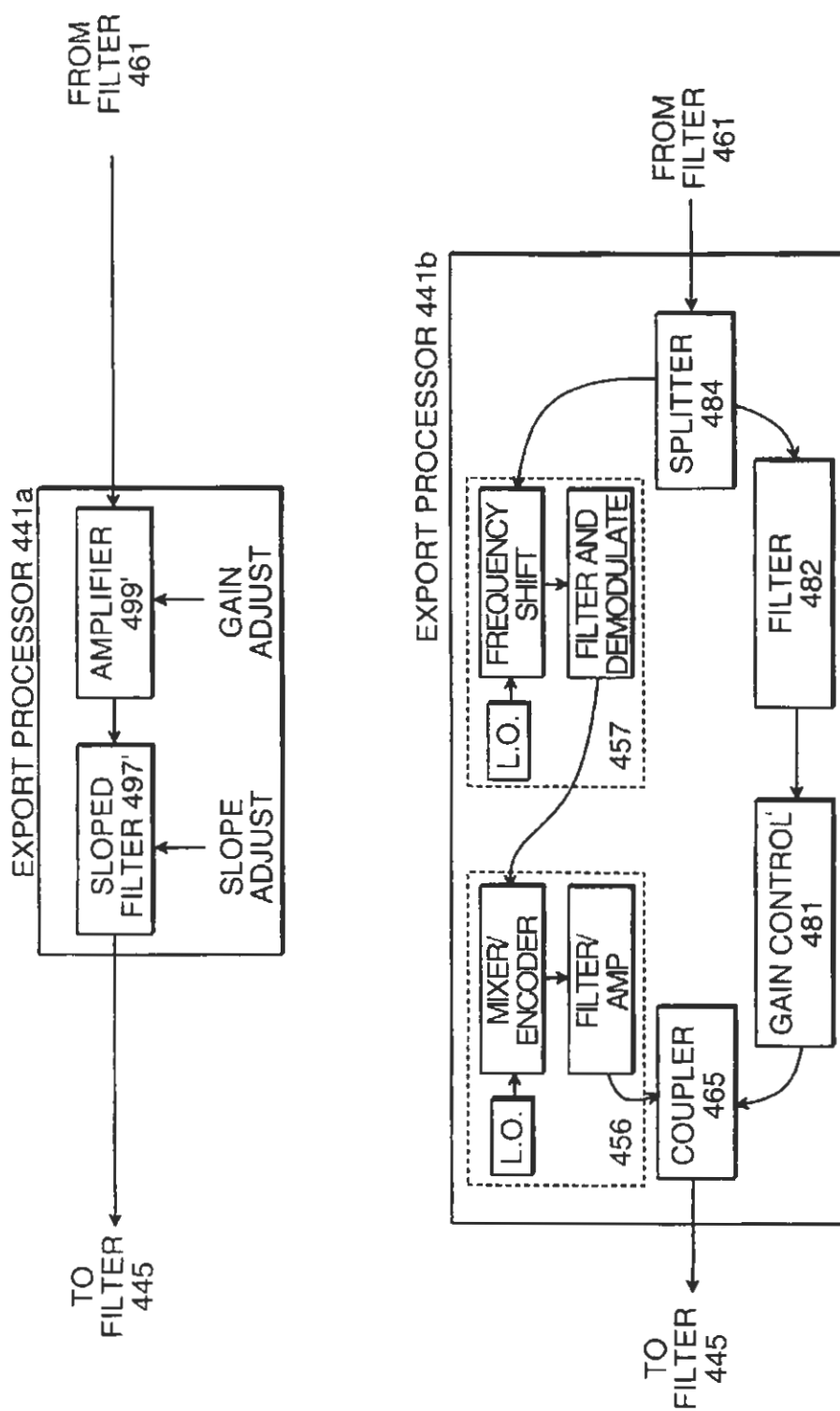
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FIG. 11c



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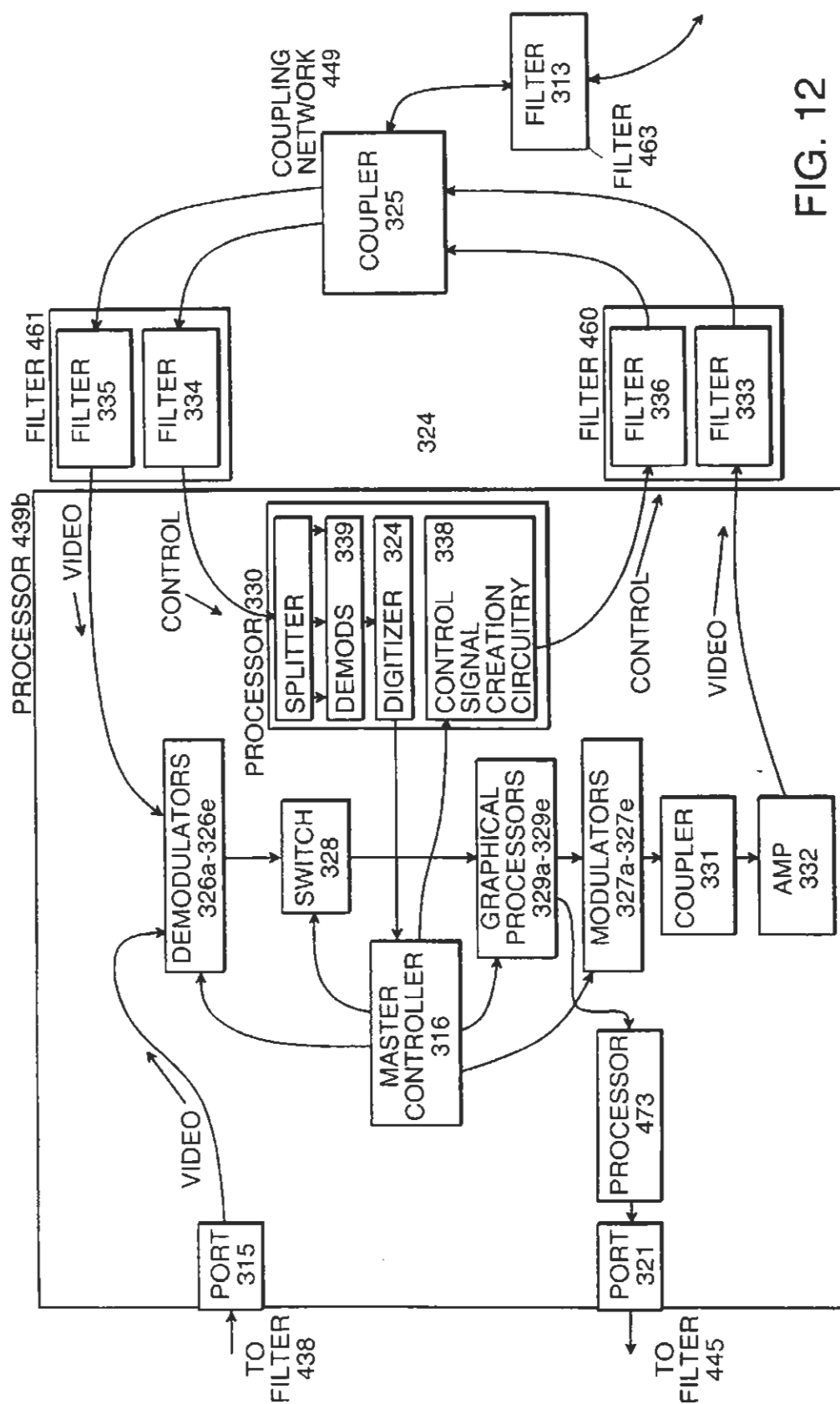


FIG. 12

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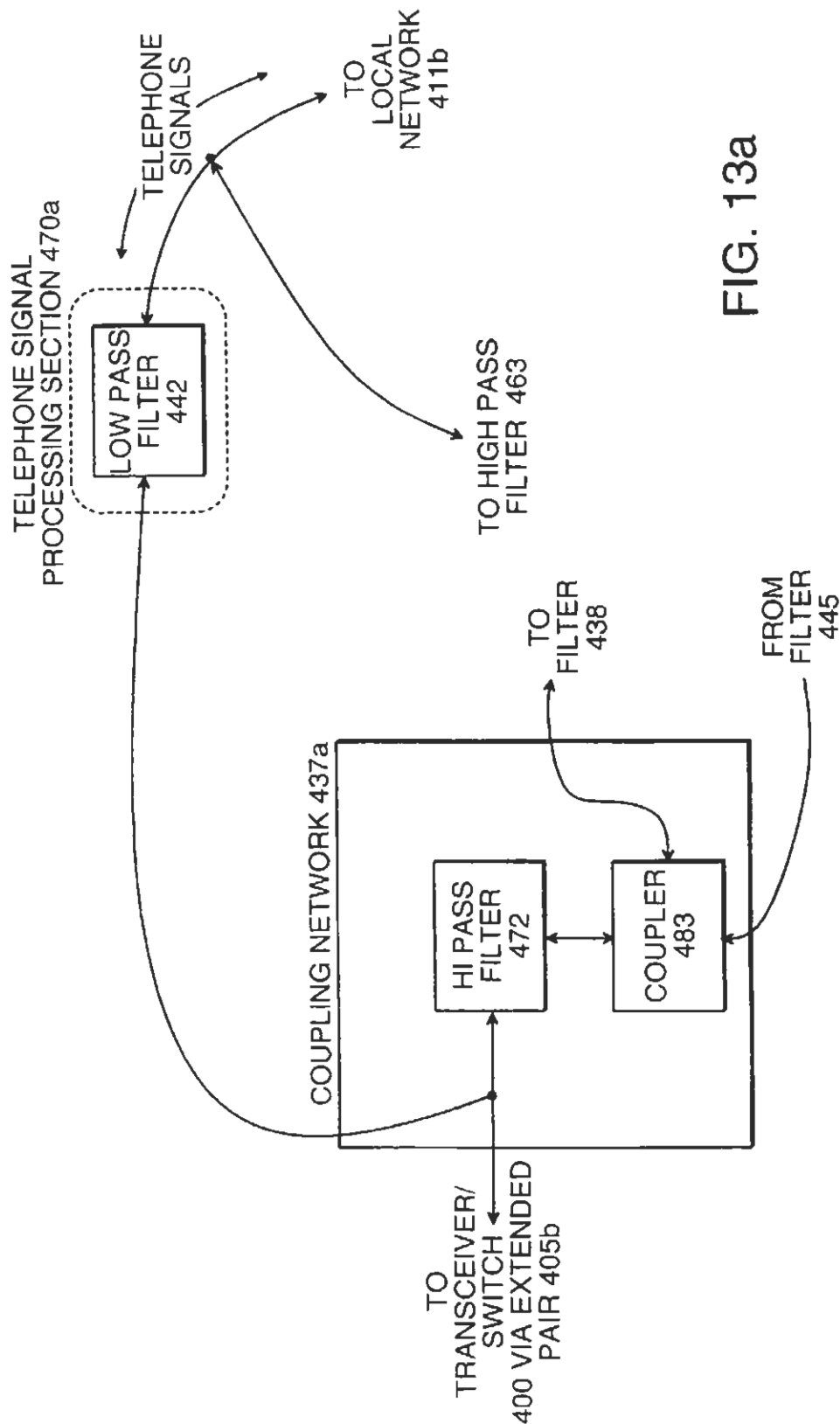


FIG. 13a

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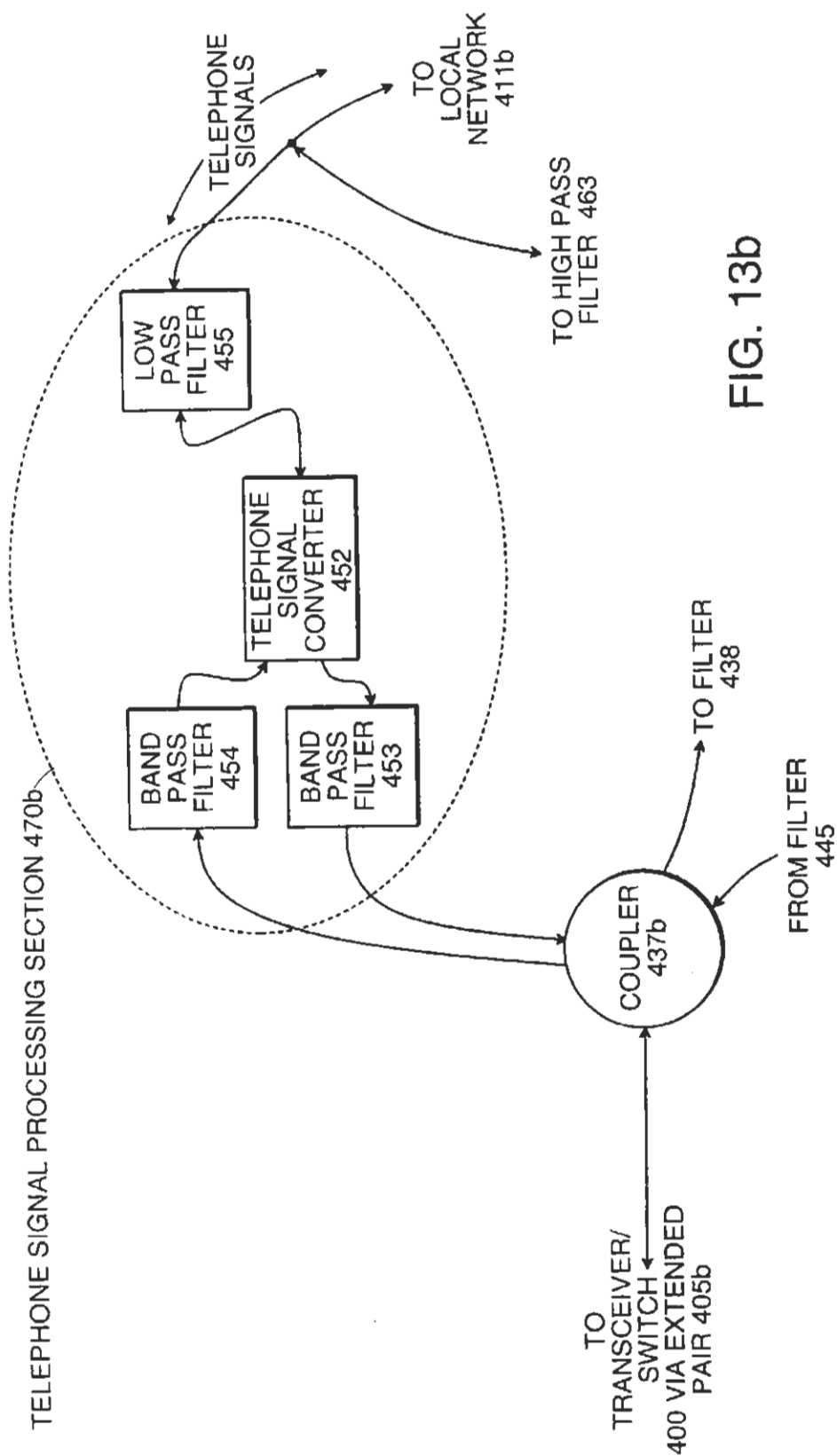


FIG. 13b

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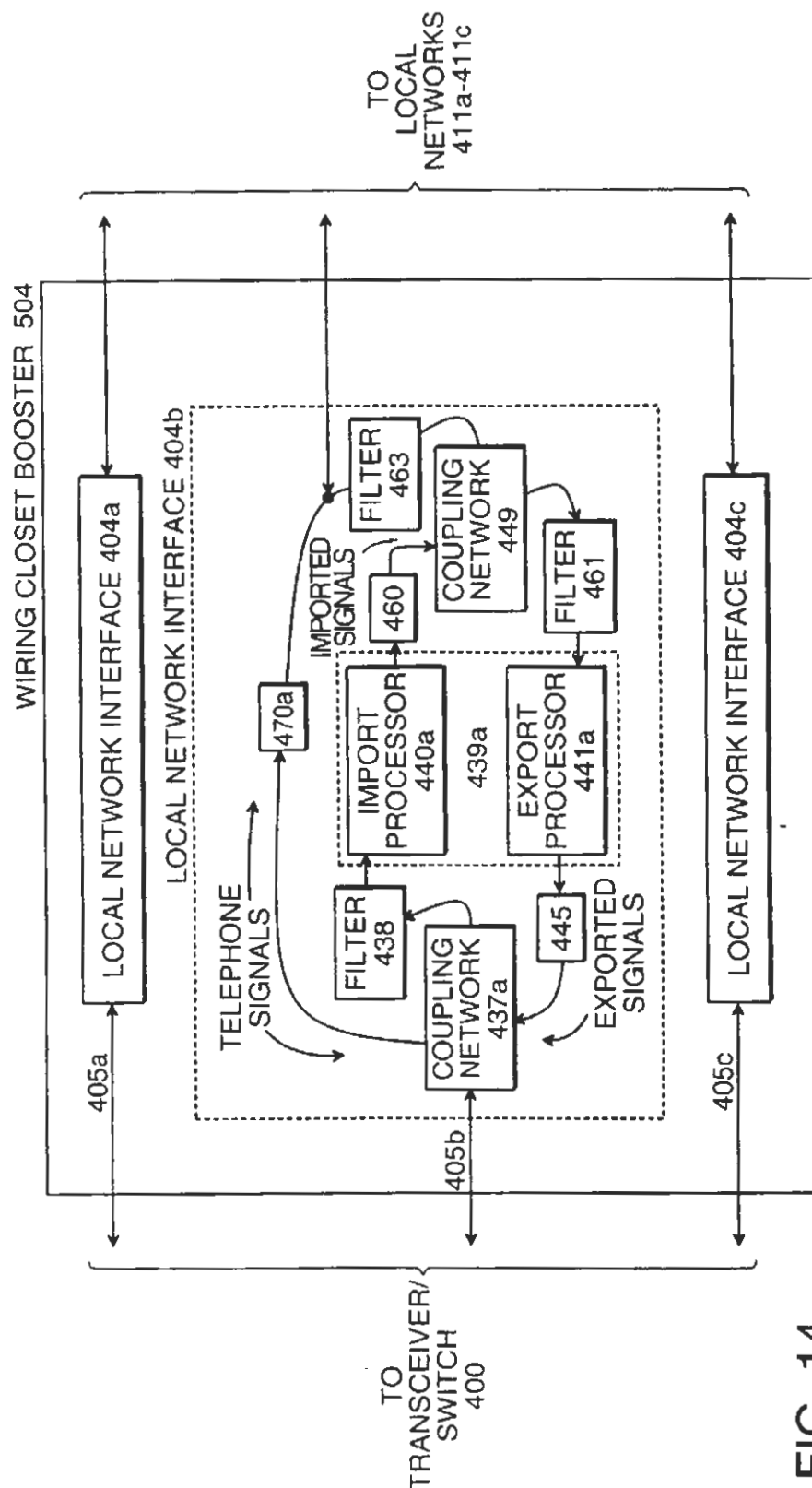


FIG. 14

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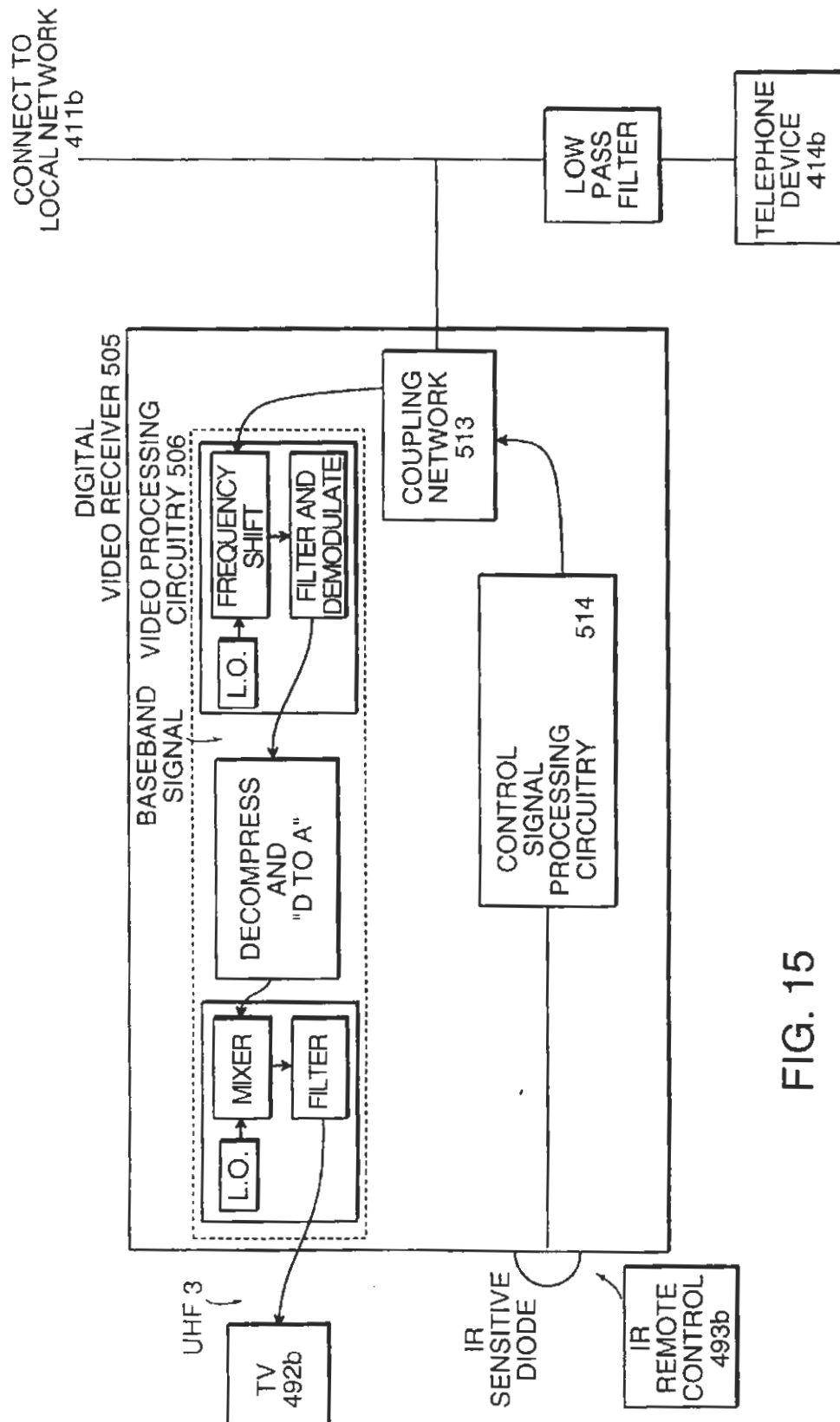


FIG. 15

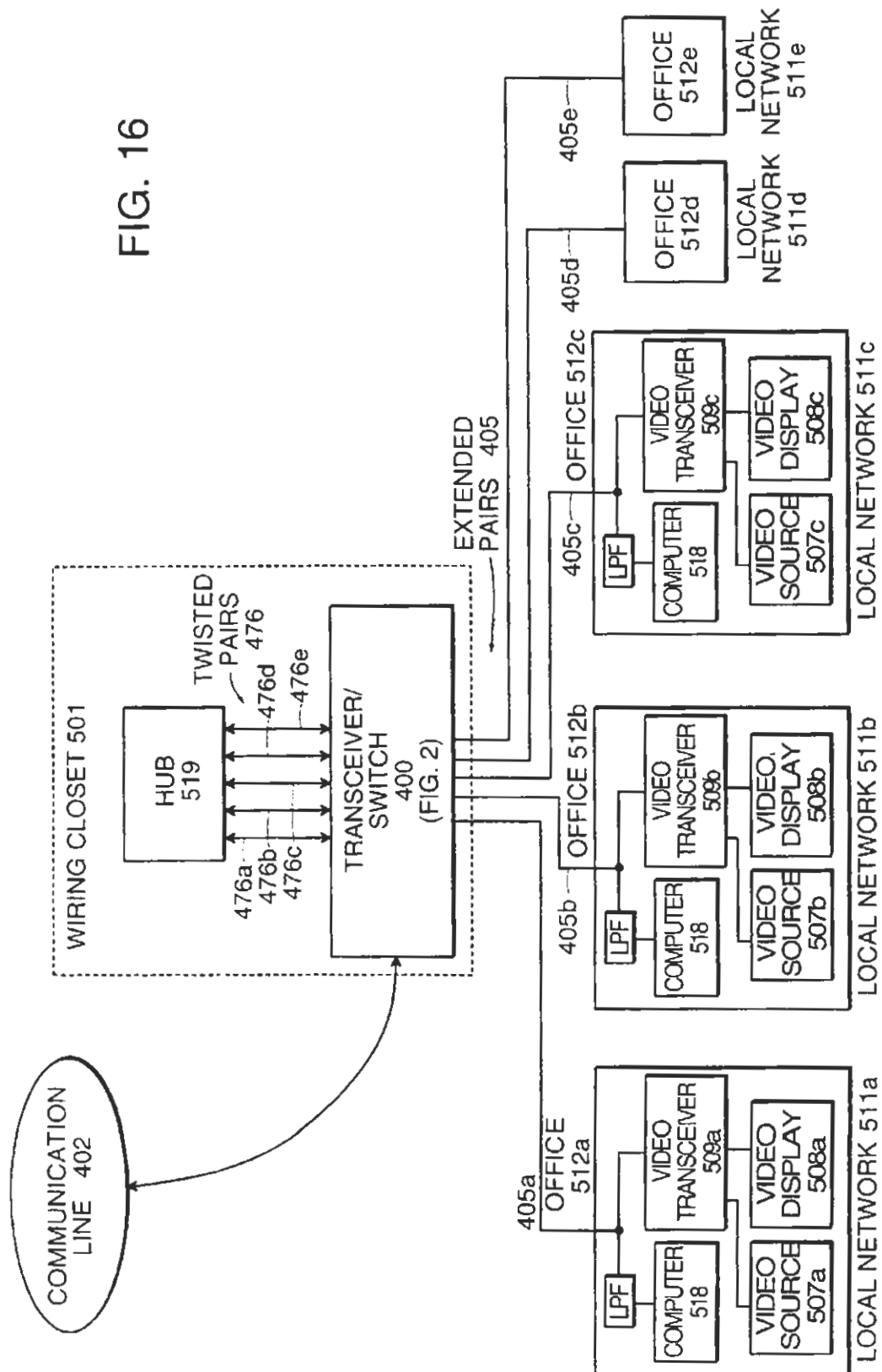
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FIG. 16



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1

DISTRIBUTED SPLITTER FOR DATA TRANSMISSION OVER TWISTED WIRE PAIRS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation and claims the benefit of priority under 35 USC 120 of U.S. application Ser. No. 09/874,733, filed Jun. 5, 2001, which is a continuation of U.S. application Ser. No. 09/362,180, filed Jul. 27, 1999, issued as U.S. Pat. No. 6,243,446 on Jun. 5, 2001, which is a continuation of U.S. application Ser. No. 09/191,168, filed Nov. 13, 1998, issued as U.S. Pat. No. 6,185,284, issued Feb. 6, 2001, which is a continuation of application Ser. No. 08/814,837, filed Mar. 11, 1997, issued as U.S. Pat. No. 5,844,596, issued Dec. 1, 1998, which is a continuation of application Ser. No. 08/673,577, filed Jul. 1, 1996, now abandoned which is a continuation of application Ser. No. 08/545,937, filed Oct. 20, 1995, now abandoned which is a continuation of application Ser. No. 08/372,561, filed Jan. 13, 1995, now abandoned which is a continuation of application Ser. No. 08/245,759, filed May 18, 1994, now abandoned which is a continuation of application Ser. No. 08/115,930, filed Aug. 31, 1993, now abandoned which is a continuation of application Ser. No. 07/802,738, filed Dec. 5, 1991, now abandoned which is a continuation-in-part of application Ser. No. 07/688,864, filed Apr. 19, 1991, now abandoned which is a continuation of application Ser. No. 07/379,751, filed Jul. 14, 1989, issued as U.S. Pat. No. 5,010,399 on Apr. 23, 1991. The disclosure of the prior applications are considered part of and are incorporated by reference in the disclosure of this application.

INTRODUCTION

The present invention relates to a system for simultaneous two-way communication of video signals and other signals between multiple networks of telephone wiring whose twisted pairs converge together into a single bundle, wiring block, or other common point of access, and a high capacity communication line located at that point of access. Each network includes a set of interconnected, active telephone wires (i.e., a group of wires that create a conductive path for telephonic signals) internal to a house, an apartment unit, or a room in a commercial building. (Such wiring internal to houses, apartment units, or rooms in commercial buildings shall be referred to herein as "local networks.") In the case of houses, the point of common access can be a telephone pole. In the case of apartment buildings, the point of access can be the "wiring closets" found in those buildings. In the case of commercial buildings, the point of access can be the electronic PBX, or "private branch exchange" common to those types of buildings. The high capacity line can be a coaxial cable or an optical fiber. In addition to communication between each network and the high capacity line, communication from one network to another is also provided.

This invention is partly an outgrowth of technology presented in the parent application, and two other continuations-in-part thereof, respectively entitled "RF Broadcast System Utilizing Internal Telephone Lines" (hereinafter, the "first CIP application") and "Cable TV Distribution and Communication System Utilizing Internal Telephone Wiring" (hereinafter, the "second CIP application"). The first and second CIP applications were filed on the same day as this application. The parent application and the first and second CIP applications are incorporated herein by reference.

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The communication systems disclosed in the parent and first and second CIP applications are designed to simultaneously transmit telephone signals and non-telephonic signals (such as cable television signals, other video signals, audio signals, data signals, and control signals) across the active telephone wiring internal to (i.e., locally within) residences and other structures. The present invention adds to these techniques, providing distribution of all of these signals to a local network of active telephone wiring (i.e. the wiring internal to a house, apartment unit, or a room in a commercial building) from a distribution device that connects to the trunk line of a public or private telephone network. That device is located where the telephone lines for multiple local networks converge to meet the public network trunk (or PBX, in the case of office buildings), enabling the distribution device to perform communication functions for many local networks at once, including communication between one local network and another. The distribution system works just as well when the point of convergence is the center of a computer communications network with a "star" topology, and the wires are the twisted pair wires connecting each individual computer to this center.

BACKGROUND OF THE INVENTION

The current method of providing cable TV signals to a house requires that a cable branch (typically a coaxial cable) connect from the main cable trunk to each subscriber. In addition, at the end of the subscriber branch, an additional segment of the coaxial cable must be installed for every extra TV "hookup" within the residence.

The challenge of providing cable TV to an apartment building is even more formidable. If coaxial cabling is not included at the time of construction, a coaxial cable leading through the entire building must be installed, and a branch must connect between each of the individual apartment units to a point on this cable. This is obviously an expensive procedure, even if easily accessible cabling conduits exist. Furthermore, each branch provides service at only one location within the unit it connects. Extra branches must be installed to provide cable TV service at other locations in the unit.

Providing a group of TV signals to various rooms in an office building currently requires a similar amount of coaxial cable installation. The demand for economical video distribution within office buildings is increasing, moreover, because of the increased popularity of video teleconferencing.

The method of distributing cable TV signals commonly used in the U.S. can be called a "one-way branched" system because signals transmitted at the head-end (i.e., at the root or entrance point to the network) spread across to each of the various subscribers by continually splitting into multiple downstream branches. Due to an increase in the popularity of video programming, however, demand for a new system has emerged. Under the new system, sometimes called "video on demand," a subscriber can request a specific program from a library of programs stored at a central location on, for example, video tapes. The signal from this program is subsequently sent to the subscriber from the "head end" of the system. No other viewers can receive the same signal unless they make a similar request.

One method for providing video on demand is to install a high-capacity fiber optic transmission line from the library through a series of residential or commercial neighborhoods. At each neighborhood, all signals targeted for the local residences or businesses (hereinafter, the term "residence" is